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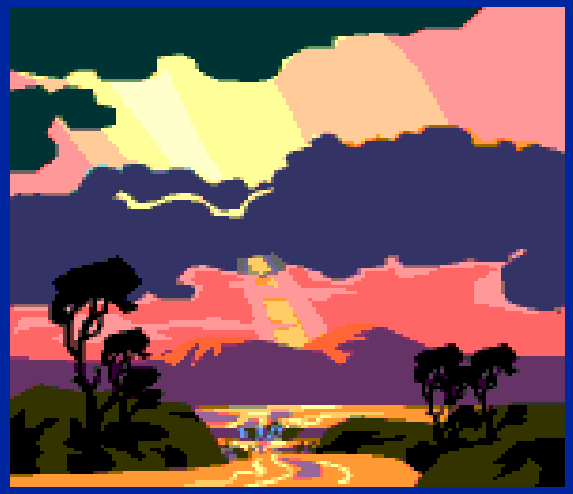

Terry L. Walker

FY08 ARMY IRP/MMRP Workshop

4-6 December 2007

MULTI-INCREMENT SAMPLING CONSIDERATIONS

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PREVIEW

- MIS history, approach, benefits and issues
- Laboratory issues
- Risk Assessment issues
- Guidance
- Summary

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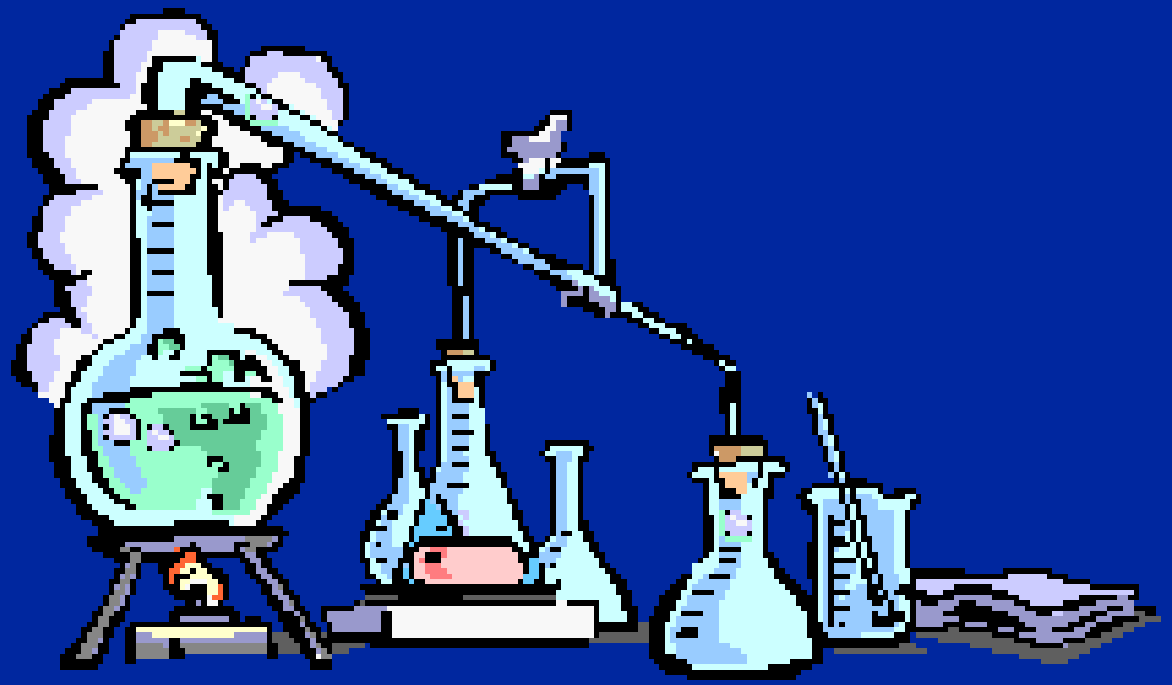
APPENDIX A to SW846 METHOD 8330B



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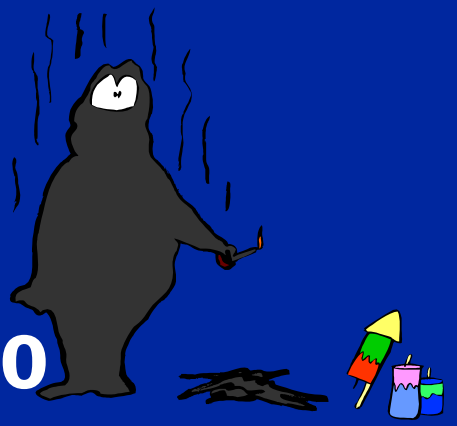
HISTORY OF MIS

- Initially advocated by USEPA (soil screening guidance)
- Studies at explosives-contaminated sites (USACE CRREL)
  - Sampling error was at least 10 times greater than analytical error
  - Major source of analytical error was found to be sample processing and subsampling



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WHAT IS THE MIS APPROACH?

- Pooling of several individual increments from within the decision unit (can you say “composite”????)
- Intended to provide a more reliable estimate of the AVERAGE concentration
- Collection of field replicate samples (typically three) to provide an estimate of total uncertainty

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WHAT IS THE MIS APPROACH?

- Minimizes sampling and subsampling errors
- Normalizes data distribution (?)
- Reduces analytical costs compared with multiple discrete samples (?)

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SAMPLING ERRORS ADDRESSED BY MIS

- **Compositional heterogeneity: not all particles within a population have the same concentration of target analytes**
  - **Maximum when analyte is present as a few discrete particles of pure material**
- **Distributional heterogeneity: contaminant particles scattered across the site unevenly**
  - **Maximum when a single discrete sample is used to estimate the mean for a large decision unit**

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BENEFITS OF MIS

- Reduces field sampling and laboratory sub sampling processing induced errors
- Improves data reliability and better represents site characteristics
- Enables fewer samples for risk analysis (?)
- Reduces number of samples for lab analysis
- Less chance for missed contaminants

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MIS ISSUES

- How is decision unit established?
- What should the sampling depth be?
- Three replicate samples recommended (is that enough?)(statistics?)
- May mask areas of “high concentrations” (i.e., hot spots)
- What are appropriate “action levels” based on multi-incremental samples?

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MIS ISSUES

- How should increments be collected?
  - Systematic-random sampling design
  - Collection of replicate samples
- What should the sample mass be to overcome compositional heterogeneity?
  - 1 kg or more
- How many increments are necessary to overcome distributional heterogeneity within the decision unit?
  - 30 grabs or more
- How large of an area can be adequately characterized with a multi-increment sample?
  - Decision unit is typically 25 to 10,000 m^2

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LABORATORY ISSUES

- Must have space to air dry MIS samples
- Must have grinding apparatus with adequate dust control to prevent cross-contamination
- Grinding generates heat (volatilization and thermal decomposition)
- Must have an SOP for the MIS sub-sampling

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LABORATORY ISSUES

- **Method QC issues:**
  - **Should monitor the entire analytical process (i.e. spike the sample or blank matrix before grinding)**
  - **Method QC samples — MB; LCS; MS/MSD; duplicate (or triplicate) — should be carried through the entire analytical process (including grinding)**
  - **Should process a sample in triplicate (laboratory triplicate) in order to assess the precision of the analytical process (See EPA 8330B Appendix A Section A.5.0)**
  - **What is a suitable blank matrix (for the MB and LCS)**

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LABORATORY ISSUES

- Laboratories that have demonstrated an acceptable MIS sub-sampling procedure…NONE
- Laboratories whose MIS sub-sampling procedure is being evaluated:
  - TestAmerica Denver of Arvada, CO
- Laboratories requested (by USACE Districts) to have their MIS sub-sampling procedure evaluated:
  - GPL Laboratories, LLLC of Frederick, MD
  - TestAmerica Chicago of University Park, IL
- Laboratories “rumored” to have a MIS sub-sampling procedure:
  - TestAmerica Honolulu of Aiea, HI (formerly Oceanic Analytical Laboratory Incorporated)

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RISK ASSESSMENT ISSUES

- Vegetation included (normally removed)
  - Analytical interferences?
- Samples are taken at 0-2” (Method 8330B)
  - Normally 0-6” or 0-12” (surface soil)
  - Introduces high bias for the exposure point concentration (EPC)
- Developed for surface soil sampling
  - Applicable to subsurface soil sampling?

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RISK ASSESSMENT ISSUES

- Particles >2 mm are removed
  - Safety considerations
  - Representative of actual exposures?
  - Available for analysis if required
- Grinding turns soil into talcum powder
  - Representative of actual exposures?

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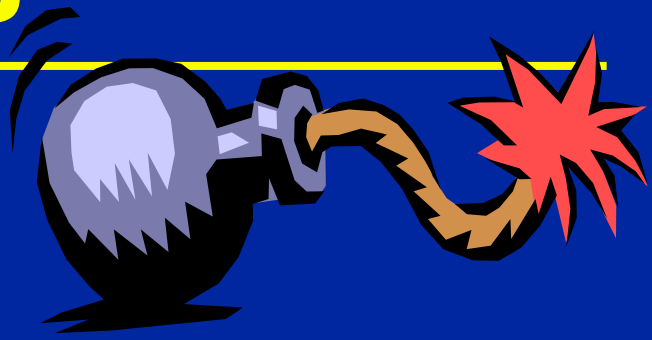
RISK ASSESSMENT ISSUES



- Derived for energetics
  - Applicable to other analytes (i.e., metals)?
- Grinding – can increase metals concentrations
  - Due to bowl and puck?
  - Due to additional exposed surface area?
  - Can be duplicated for background samples
- Does 95% UCL make sense?

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MULTI-INCREMENT SAMPLING VIDEO

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MI GUIDANCE

Alaska Dept of Environmental Conservation, Contaminated Sites Program

Guidance on Multi-Increment Soil Sampling

Draft, March 2007

- **Initially for POL only (GRO, DRO, RRO, BTEX, PAHs)**
- **Characterization of surface release (i.e., AST)**
- **Confirmation sampling**

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ALASKA GUIDANCE

"MI is meant to supplement, not replace, existing department approved approaches or statistical approaches"

"…DEC intends to address MI sampling for metals in the next edition of this guidance"

"Decision units are restricted to actual source zones and must not incorporate large, uncontaminated areas."

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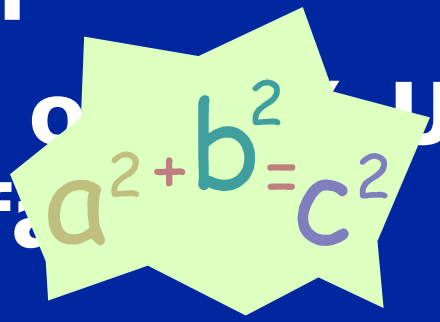
ALASKA GUIDANCE

- Decision unit is the source area
- Requires triplicate samples
- Calculation of RSD (must be < 30%), assumes normal data distribution
- Calculation o UCL (student t fa



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MORE MI GUIDANCE

- State of Hawaii, Department of Health
- *Pesticides in Former Agricultural Lands and Related Areas – Updates on Investigation and Assessment*
- May 11, 2007
- Addendum to *Screening for Environmental Concerns at Sites With Contaminated Soil and Groundwater*

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HAWAII GUIDANCE

- "Low variability, high reproducibility"
- "High level of confidence for decision making"
- Triplicates required for 10% of decision units (min. 1 set per site)

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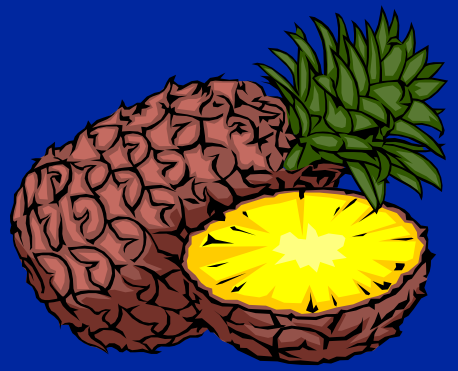
HAWAII GUIDANCE

- **Decision unit – "an area where a decision is to be made regarding the extent and magnitude of contaminants with respect to the environmental concerns posed by the contaminants"**



- **Environmental concerns:**
  - **Direct exposure to the soil**
  - **Vapor intrusion**
  - **Leaching to groundwater**
  - **Toxicity to terrestrial flora and fauna**
  - **Gross contamination (odors, explosive hazard, etc)**

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MIS SUMMARY

- It's not just changing 8330 to 8330B in planning documents
- Provides an average concentration over the decision unit (95% UCL?)
- May not be appropriate for all areas, all sites or all contaminants
- Systematic Planning Process!!!!!!!!!!!!

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MULTI-INCREMENT SAMPLING CONSIDERATIONS

QUESTIONS?

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